by-laws of the Association which will require the approval of the present general meeting and of a subsequent special general meeting, which will be duly summoned. The first proposal is to enact by by-law of the Association that the Prime Warden of the Fishmongers' Company shall always be *ex officio* a member of the Council of the Association. The Fishmongers' Company have shown their interest in the enterprise of the Association by contributing 2000*l.* to its funds. In reply to an inquiry from the Council, the Court of Assistants of the Fishmongers' Company have cordially accepted the proposition that the Prime Warden of the Company should hold the official relation to the Association above proposed. The Council therefore propose to alter By-law 2 of the Association by the insertion between the words "officers" and "and fourteen other members" of the words "the Prime Warden of the Fishmongers' Company for the time being."

The second proposal has relation to the admission of the Universities of Great Britain and Ireland to a share in the government of the Association. As was stated in the last Annual Report, members of the University of Cambridge have subscribed a sum of 500*l.* for the purpose of qualifying the University as a Governor of the Association. During the past year a similar fund has been raised by members of the University of Oxford. At the annual general meeting in June 1885, in view of these proceedings, the following addition to By-law 17 was carried: "Any University of the United Kingdom, on the payment of 500*l.* to the Association by members of the University, shall, if the Council of the Association consent thereto, acquire as a consequence the perpetual right of nominating one member of the Council of the Association."

The Council now propose to erase the words just cited, and to substitute the following:—

"Any University of the United Kingdom, on the payment of 500*l.* to the Association in the name of the University and for the purpose of acquiring the right herein specified, shall, if the Council of the Association assent thereto, become a Governor of the Association, and acquire the perpetual right of nominating annually one member of the Council of the Association to serve for one year (from the annual meeting in one year to that in the following year); and any resident member of the University subscribing 100*l.* or more to such fund of 500*l.*, shall, in virtue of such subscription, become a 'Founder' of the Association."

VII. The Council have again to record a severe loss to the Association in the list of its Vice-Presidents owing to the death of Dr. W. B. Carpenter, C.B., F.R.S. Dr. Carpenter was a warm supporter of the Association, and contributed largely by his advocacy of its objects to the success which has now been attained.

VIII. The Council do not propose any change in the list of Officers, Vice-Presidents, and Council for the ensuing year. They desire to notify that the following gentlemen have qualified by subscription of 500*l.* each as Life-Members (Governors) of the Council, viz. Mr. Robert Bayly, of Plymouth, 1885; Mr. Bazley White (Clothworkers' Company), 1885; Mr. E. L. Beckwith (Fishmongers' Company), 1885; and Mr. John Bayly, of Plymouth, 1886.

IX. During the ensuing year the building at Plymouth will be in course of erection. It is anticipated that the chief duty of the Council during this period will be to organise a scheme of investigation to be carried out at Plymouth when the Laboratory is in working order.

It will be especially the business of the Council to determine the conditions under which the Laboratory shall be accessible to the naturalists of the United Kingdom and other countries for the purpose of aiding in those inquiries into the life-history of marine animals and plants, and particularly of food-fishes, which it is the purpose of the Association to foster.

X. The plan of the Laboratory building includes a library. The Council take the present opportunity of asking for donations of works relating to fisheries and to marine zoology and botany for the library. They will also be glad to receive subscriptions towards a special library fund, in reference to which and all similar matters, the Hon. Secretary, Prof. Lankester, can be consulted.

XI. In conclusion, the Council desire again to express the great obligation which the Association is under towards the Council of the Linnean Society for the continued permission accorded by that body to the Association to meet in the rooms of the Society.

MEMORANDUM RELATING TO THE MODE IN WHICH SCIENTIFIC KNOWLEDGE CAN BE MADE USEFUL TO ENGLISH FISHERIES

THE following Memorandum has been presented to the President of the Board of Trade and officially acknowledged by him:—

Without committing ourselves to all the statements and opinions contained in the subjoined Memorandum, we, the undersigned, wish to state that we concur generally with the views as to the proposed constitution of the new Fishery Department therein expressed—

Argyll, K.G., F.R.S.; Walsingham; Stalbridge; E. Marjoribanks, M.P., Member of the late Royal Commission on Trawling; John Lubbock, Bart., M.P., F.R.S.; James Paget, Bart., F.R.S.; Henry W. Acland, K.C.B., F.R.S.; J. Fayrer, K.C.S.I., F.R.S., Honorary Physician to the Queen, Physician to the Secretary of State for India in Council; C. Spence Bate, F.R.S., Member of Council of the Marine Biological Association; I. Bayley Balfour, F.R.S., Sherardian Professor of Botany in the University of Oxford; Ed. Lonsdale Beckwith, late Prime Warden of the Fishmongers' Company, Member of Council of the Marine Biological Association; F. Jeffrey Bell, F.Z.S., Professor of Zoology in King's College, London, Member of Council of the Marine Biological Association; Henry B. Brady, F.R.S.; W. S. Caine, M.P., Member of the late Royal Commission on Trawling; P. H. Carpenter, F.R.S.; W. H. Dallinger, F.R.S., President of the Royal Microscopical Society; F. Darwin, F.R.S.; W. T. Thiselton Dyer, C.M.G., F.R.S., Director of the Royal Gardens, Kew, Member of Council of the Marine Biological Association; W. H. Flower, F.R.S., Superintendent of the British Museum, Natural History, President of the Zoological Society, Vice-President of the Marine Biological Association; Hans Gadow, Strickland Curator and Lecturer on Animal Morphology in the University of Cambridge; Arthur Gamgee, F.R.S., Fullerian Professor of Physiology in the Royal Institution of Great Britain; W. H. Gaskell, F.R.S.; A. Günther, F.R.S., Keeper of the Zoological Department of the British Museum, Member of Council of the Marine Biological Association; S. F. Harmer, Fellow of King's College, Cambridge; W. A. Herdman, Professor of Zoology in University College, Liverpool, Member of Council of the Marine Biological Association; G. M. Humphry, F.R.S., Professor of Surgery in the University of Cambridge, late Professor of Anatomy, Fellow of King's College; J. N. Langley, F.R.S., Fellow of Trinity College, Cambridge; E. Ray Lankester, F.R.S., Jodrell Professor of Zoology in University College, London, Fellow of Exeter College, Oxford, Hon. Sec. of the Marine Biological Association; A. Milnes Marshall, F.R.S., Professor of Zoology in Owens College, Manchester, Member of Council of the Marine Biological Association; W. C. McIntosh, F.R.S., Professor of Natural History in the University of St. Andrews, Vice-President of the Marine Biological Association; H. N. Moseley, F.R.S., Linacre Professor of Human and Comparative Anatomy in the University of Oxford, Chairman of Council of the Marine Biological Association; Geo. J. Romanes, F.R.S., Member of Council of the Marine Biological Association; J. Burdon Sanderson, F.R.S., Waynflete Professor of Physiology in the University of Oxford; E. A. Schäfer, F.R.S., Professor of Physiology in University College, London; P. L. Sclater, F.R.S., Secretary of the Zoological Society, Member of Council of the Marine Biological Association; Adam Sedgwick, F.R.S., Fellow of Trinity College, Cambridge, Member of Council of the Marine Biological Association; C. Stewart, F.L.S., Conservator of the Museum of the Royal College of Surgeons, Member of Council of the Marine Biological Association; D'Arcy W. Thompson, Professor of Zoology in University College, Dundee; Sydney H. Vines, F.R.S.; W. F. R. Weldon, Fellow of St. John's College, Cambridge; Frank Crisp, Vice-President of the Linnean Society, Hon. Treasurer of the Marine Biological Association; Peter Eade, President, on behalf of the Norfolk and Norwich Naturalists' Society; J. Gurney, Mayor of Norwich, R. E. Burroughes, H. W. Stafford, John B. Pearce, Harry Bullard, S. Gurney Buxton, and John Barwell, Conservators under the Norfolk and Suffolk Fisheries Act, 1877, for the City of Norwich; C. Louis Buxton, T. C. Blofeld, and E. Frost, Mayor of Thetford, Conservators for Norfolk; B. F. Grimsey, Mayor of Ipswich, and Lieut.-Col. H. M. Leathes, Conservators for Suffolk; F. B. Archer, Conservator for Lynn; C. J. Greene, Hon. Sec. of the

Yare Preservation Society; Lieut.-Col. F. H. Custance; Michael Beverley, M.D.; H. W. Bidwell; G. F. Buxton; H. W. Fielden, late Naturalist to Sir G. Nares's Arctic Expedition; Thos. Southwell.

I.—*Preface*

(1) The necessity for an administration of our marine and fresh-water fisheries based upon thorough or scientific knowledge of all that relates to them has become obvious of late years. The Trawling Commission of 1884-85 has reported to this effect in so far as the subject of their inquiries is concerned. Other nations have adopted such a method of dealing with their fisheries, with good results and the promise of better.

(2) The inquiries and operations necessary cannot be conducted as the result of private commercial enterprise. They must be national in character.

(3) Whilst the general trade returns of the fishing industry, on the one hand, and the practical enforcing of regulations as to the protection of fishing-grounds and the restriction of fishing operations within certain seasons and localities are matters with which an ordinary staff of officials can effectually deal, yet the chief purposes of the operation of a satisfactory Fisheries Department are of such a nature that only expert naturalists can usefully advise upon them and carry them out. It is therefore important that the organisation of a State Fisheries Department should either be primarily under the control of a scientific authority who should direct the practical agencies as to trade returns and police, or that there should be distinct and parallel branches of the Department—the one concerned in scientific questions, the other in collecting trade returns and in directing the fisheries police.

(4) It does not appear that there is any ground for supposing that individuals of scientific training are *ipso facto* unfitted for administrative duties, and there would be obvious advantages in placing the operations of a Fisheries Department under one head. Indeed, it may be maintained that an education in scientific matters, and capacity for scientific work, is likely to produce a more practical and enterprising director of such a Department than could elsewhere be found. It has not been found desirable to place the administration of the important botanical institution at Kew in the hands of a non-scientific director, and there is no obvious reason for avoiding the employment of a scientific staff in the case of a Fisheries Department.

II.—*Nature of the Work to be done*

(1) Generally to ascertain what restrictions or modifications in the proceedings of fishermen are desirable, so as to insure the largest and most satisfactory returns prospectively as well as immediately from the fishing-grounds of the English coast and from English rivers and lakes.

(2) Especially to ascertain whether existing fishing-grounds can be improved by the artificial breeding of food-fishes and shell-fish, and to determine the methods of carrying on such breeding, and to put these methods into practice.

(3) To find new fishing-grounds.

(4) To introduce new fish—either actually new to the locality or new to the consumer.

(5) To introduce (if practicable) methods of rearing and fattening marine fish in stock-ponds.

(6) To look after the cultivation and supply of bait.

(7) To introduce new baits, new methods of fishing, improved nets, improved boats, new methods of transport and of curing.

The work can be divided into two sections. A. Investigation; B. Practical Administration.

A. *Investigation.*—The inquiries which are necessary in order to effect the purposes indicated above are as follows:—

(1) A thorough physical and biological exploration of the British coasts within a certain distance of the shore-line, especially and primarily in the neighbourhood of fishing-grounds. The investigation must include a determination of temperature and currents at various depths, the nature of the bottom, the composition of the sea-water, and the influence of rivers and conformation of coast upon these features. At the same time the entire range of the fauna and flora must be investigated in relation to small areas so as to connect the varying living inhabitants of different areas with the varying physical conditions of those areas and with the varying association of the living inhabitants *inter se*. Only in this way can the relation of food-fishes to the physical conditions of the sea, and to their living associates be ascertained and data furnished for ultimately determining the causes of the local distribution of different kinds of food-fishes and of the periodic migrations of some kinds of them.

(2) A thoroughly detailed and accurate knowledge of the food, habits, and movements of each of the important kinds of food-fishes (of which about five-and-twenty, together with six shell-fish important either as food or bait, may be reckoned). The relation of each of these kinds of fish to its fishing-ground must be separately ascertained; its time and mode of reproduction, the mode of fertilisation of its eggs, the growth of the embryo, the food and habits of the fry, the enemies of the young and of the adult, the relation of both young and adult to temperature, to influx of fresh water, to sewage contamination, to disturbing agencies such as trawling, and ordinary traffic.

(3) An inquiry as to whether over a long period of years there has been an increase or a decrease in the abundance of each kind of food-fish on the chief fishing-grounds as a matter of fact, together with an inquiry as to the actual take of each kind of fish in successive years, and further an inquiry as to any accompanying variation in (*a*) the number of fishing-boats; (*b*) the methods of fishing; (*c*) the climatic conditions or other such possibly influential conditions as previous inquiry may have suggested.

(4) An inquiry for the purpose of ascertaining experimentally whether the decrease in the yield of fishing-grounds, in regard to each several species of food-fish can be remedied: (*a*) by artificial breeding of the fish; (*b*) by protecting the young; (*c*) by increasing its natural food; (*d*) by destruction of its enemies; (*e*) by restrictive legislation as to time or place of fishing and as to size of fish which may be taken and character of fishing apparatus which may be used.

(5) An inquiry to ascertain whether, if periodic, natural causes are at work in determining the fluctuations of the yield of fishing-grounds, their effect can be foretold, and whether this effect can in any case be counteracted; similarly to ascertain in the case of migratory shoal-fish whether any simple and trustworthy means can be brought into operation for the purpose of foretelling the places and times of their migrations so as to enable both fishermen and fish-dealers to be ready for their arrival.

(6) An inquiry into the diseases of fish, especially in relation to salmon and other fresh-water fish.

B. *Practical Administration.*—The chief heads under which this presents itself as distinct from the antecedent search for reliable data are:—

(1) The management of an efficient "intelligence department," giving weekly statistics of the fishing industry, the appearance and disappearance of certain fish at particular spots, the number of fishing-boats employed, the methods of fishing employed, the meteorological conditions.

(2) The advising and enforcing of restrictions by the Legislature as to time, place, and method of capture of fish.

(3) The artificial breeding and rearing of fish to stock impoverished fishing-grounds.

(4) The leasing and management of the foreshore and sea-bottom in particular spots, for the purposes of oyster-culture and mussel-culture, and of marsh-lands near the sea for the formation of tanks and fish-ponds.

(5) The opening up of new fishing-grounds and of new fish industries (curing and treatment of fish for commercial purposes).

(6) The introduction of new species of food-fish and shell-fish.

III.—*General Organisation and Staff necessary to carry on the Inquiries and to put the Results attained into Practice*

It is a matter of fundamental importance to determine, first of all, whether it is desirable that these matters should be dealt with by a permanent staff, or, on the other hand, by the occasional employment of a scientific man—not habitually occupied in these inquiries—to attempt the solution of any particular problem which an unskilled official may present to him.

Clearly there must be economy in employing permanently certain naturalists who will familiarise themselves with this

special class of questions and become experts in all that relates to fishery problems.

Further, is it desirable that the matters which are to be inquired into should be determined by an official unskilled in natural history? Or, on the other hand, that the selection of inquiries likely to lead to a satisfactory result should be made by a man of science, specially conversant with the nature of the things to be dealt with?

The organisation required consists, so far as persons are concerned, of:—

(1) A chief scientific authority.

(2) A staff of working naturalist-inspectors.

(3) A staff of clerks.

And, so far as material is concerned, of:—

(4) A London office, with collection of fishes, apparatus used in fishing, maps, survey-records, statistical returns, and library.

(5) A surveying-ship, under the orders of the Department, to be manned and maintained by the Admiralty.

(6) A chief laboratory fitted for carrying on investigations such as those named in Section II., and also two smaller movable laboratories, together with steam yacht fitted for dredging and sounding.

(7) Hatching-stations and fish-ponds.

With regard to the foregoing headings, it is a matter for consideration whether "the chief scientific authority" should be an individual or a committee of five. The position assigned to this post should be equal to that of the Director of the Geological Survey or the Director of the Royal Gardens, Kew, or, if the "authority" takes the form of a committee, it should be placed on the same footing as the Meteorological Council. The person or persons so appointed should be responsible for all the operations of the Department, and of such scientific training and capacity as to be likely to devise the most useful lines of inquiry and administration.

The "naturalist-inspectors" should be six in number, but operations might be commenced with a smaller staff. They should be thoroughly competent observers, and under the direction of the chief scientific authority they would be variously employed, either on the surveying-ship, at the chief laboratory, or in local laboratories, hatching-stations, or in the London office and museum.

The naturalists thus employed would become specialists in all matters relating to the life-history of fishes and their food; they would acquire a skill and knowledge far beyond that which it is possible to find amongst existing naturalists, who occasionally are requested to make hurried reports on such matters as salmon disease or the supposed injury of the herring-fisheries by trawlers.

One of the naturalist-inspectors should be a chemist and physicist, in order to report on the composition of the water and the nature of the bottom in the areas investigated.

"Clerks" would be required in the London office to tabulate statistics and carry on correspondence. These gentlemen need not necessarily have any scientific knowledge. It would probably be necessary to have a correspondent or agent of the Department in every large fishing centre. Probably the coast-guard officials might be taken into this service.

With regard to material equipment it appears to be necessary that a Scientific Fisheries Department should have at its London office a Museum of fishing apparatus for reference and instruction, and also complete collections illustrative of the fishes, their food, enemies, and other surroundings. In the same building would be exhibited maps showing the distribution and migrations of food-fishes, the coast temperature and its variations, the varying character of the sea-bottom, sea-water, &c.

The surveying-ship or ships would be provided by the Admiralty.

A central laboratory is in course of erection upon Plymouth Sound by the Marine Biological Association. Her Majesty's Government has promised to contribute 5000*l.* and 500*l.* a year to this institution, on condition that its resources are available for the purpose here indicated. Certain of the "naturalist-inspectors" (probably three at any one time) would be stationed at the Plymouth laboratory in order to carry on special studies of the development and food of particular species of fish.

The smaller movable laboratories, steam-yacht, and other appliances would not be costly.

ON NEW APPLICATIONS OF THE MECHANICAL PROPERTIES OF CORK TO THE ARTS[1]

IT would seem difficult to discover any new properties in a substance so familiar as cork, and yet it possesses qualities which distinguish it from all other solid or liquid bodies, namely, its power of altering its volume in a very marked degree in consequence of change of pressure. All liquids and solids are capable of cubical compression, or extension, but to a very small extent; thus water is reduced in volume by only 1/2000 part by the pressure of one atmosphere. Liquid carbonic acid yields to pressure much more than any other fluid, but still the rate is very small. Solid substances, with the exception of cork, offer equally obstinate resistance to change of bulk; even india-rubber, which most people would suppose capable of very considerable change of volume, we shall find is really very rigid.

I have here an apparatus for applying pressure by means of a lever. I place a piece of solid india-rubber under the plate and you see that I can compress it considerably by a very light pressure of my finger. I slip this same piece of india-rubber into a brass tube, which it fits closely, and now you see that I am unable to compress it by any force which I can bring to bear. I even hammer the lever with a mallet, and the blow falls as it would on a stone. The reason of this phenomenon is, that in the first place, with the india-rubber free, it spread out laterally while being compressed longitudinally, and consequently the volume was hardly altered at all; in the second case, the strong brass tube prevented all lateral extension, and because india-rubber is incapable of appreciable cubical compression, its length only could not be sensibly altered by pressure.

Extension, in like manner, does not alter the volume of india-rubber. In this glass tube is a piece of solid round rubber which nearly fills the bore. The lower end of the rubber is fixed in the bottom of the tube, and the upper end is connected by a fine cord to a small windlass, by turning which I can stretch the rubber. I fill the tube to the brim with water, and throw an image of it on to the screen. If stretching the rubber either increases or diminishes its volume, the water in the tube will either overflow or shrink in it. I now stretch the rubber to about 3 inches, or one-third of its original length, but you cannot see any appreciable movement in the water-level, hence the volume of the rubber has not changed.

Metals when subjected to pressures which exceed their elastic limits, so that they are permanently deformed, as in forging or wire-drawing, remain practically unchanged in volume per unit of weight.

I have here a pair of common scales. To the under sides of the pans I can hang the various specimens that I wish to examine; underneath these are small beakers of water which I can raise or lower by means of a rack and pinion. Substances immersed in water lose in weight by the weight of their own volume of water; hence if two substances of equal volume balance each other in air, they will also balance when immersed in water, but if their volumes are not the same, then the substance having the smaller volume will sink, because the weight of water it displaces is less than that displaced by the substance with the larger volume. To the scale on your left hand is suspended a short cylinder of ordinary iron, and to the right-hand scale a cylinder of ordinary copper. They balance exactly. I now raise the beakers and immerse the two cylinders in water; you see the copper cylinder sinks at once, and I know by that that copper has a smaller volume per pound than iron, or, as we should commonly say, it is heavier than iron. I now detach the copper cylinder, and in its place hang on this iron one, which is made of the same bar as its fellow cylinder, but forced, while red hot, into a mould by a pressure of sixty tons per square inch and allowed to cool under that pressure. The two cylinders balance, as you see. Has the volume of the iron in the compressed cylinder been altered by the rough treatment it has received? I raise the beakers, immerse the cylinders, the balance is not destroyed; hence we conclude that although the form has been changed the volume has remained the same. I substitute for the hot compressed cylinder one pressed into a mould while cold, and held there for some time, with a load of sixty tons per square inch; the balance is not destroyed by immersion, hence the volume has not been altered. I can repeat the experiments with these copper cylinders and the

[1] A Paper read at the Royal Institution of Great Britain on April 9, 1886, by William Anderson, M.Inst.C.E., M.R.I.